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Sustainable and Biodegradable Nanocellulose Composite Materials

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Introduction:

Nanocellulose is made from mixing cellulose powder **(Figure 1)** and a variety of different materials and liquids. The biggest problem with making nanocellulose is the cost, and time. When set out to dry, the nanocellulose mixture tends to shrink significantly **(Figures: 6 & 7)**. This leads to us making big batches, but after setting them out to dry, getting back very little results. The goal of the following experiments and research was to reduce the amount that the nanocellulose shrinks, so that we could make it a more time and money conscience material.

Methods

1. In order to make nanocellulose, you must mix it with a liquid, and if desired, another material. Mixed most often was cellulose powder with distilled water. The amount of each product was changed with each trial, in order to get a variety of different tests.

a. In order to get different tests, different mixtures were also made. Including mixing cellulose powder with Isopropanol or IPA alcohol for short

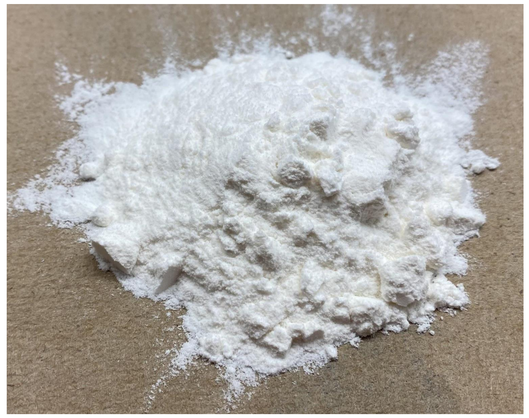

Figure 1: Cellulose powder before being mixed with any other materials or liquids.

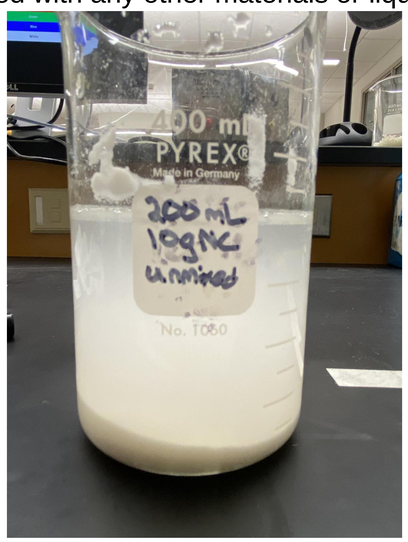

Figure 2: 200 mL H2O and 10 grams Cellulose Unmixed

Methods Continued:

b. Another mix included fine textured pine sawdust **(Figure 3)**, in hopes of being a bonding agent for the cellulose

2. In order to mix all of the test, we used ultrasonication. Ultrasonication uses ultrasound waves from a probe. (shown in **(Figure 5)** These soundwaves violently agitate the particles, which causes the cellulose, and whatever else is in the beaker, to mix with each other. The probe is put into the mixture, run for 5 minutes at 80% duty cycle, which agitates the mixture into a solution

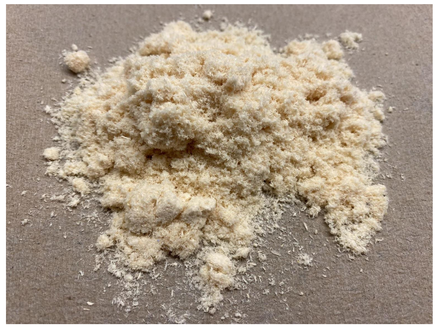

Figure 3: Fine Textured Pine Sawdust Used in Experiments

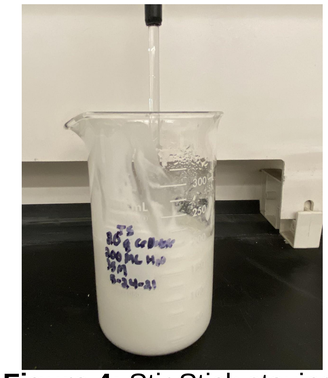

Figure 4: Stir Stick staying directly up due to viscosity

Figure 5: Ultrasonication machine. Ran at 400 watts, 10 degrees Celsius, 80% duty cycle, at 5 minute increments.

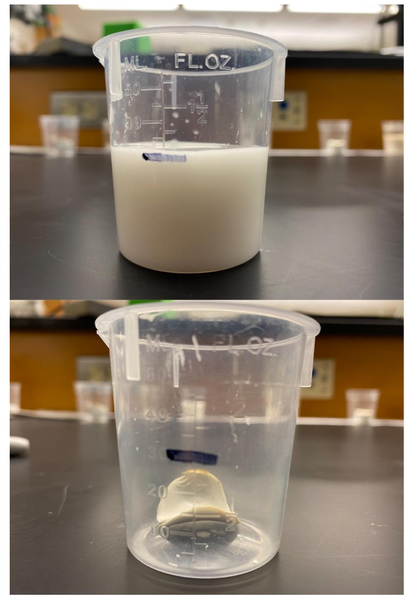

Figure 6: Example of shrinkage. Starting at 30 mL and 31.46g, and shrinking below 10 mL, and 1.21g. (20 g of 100g200IPA Sludge + 200 mL H2O)

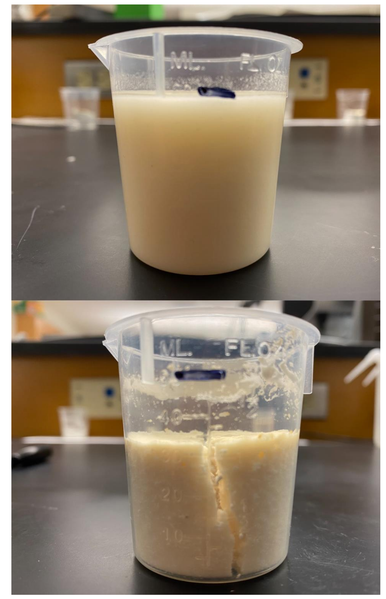

Figure 7: Example of shrinkage. Starting at 50 mL, and shrinking. (100H2O + 150 IPA + 2 Sawdust) *Not Fully Dry Yet*

Citations & Acknowledgements:

Yang, B., & Bashir, M. J. K. (n.d.). *Ultrasonication*. Ultrasonication - an overview | ScienceDirect Topics. https://www.sciencedirect.com/topics/engineering/ultrasonication.

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